Task Force Final Report to the Implementation Committee
Directive No. 98-4: Interstate Animal Waste Distribution and Use Technology
October 1, 1999

Report Summary

Background:

The 1998 Chesapeake Executive Council signed Directive 98-4 in support of the nutrient reduction goals of the 1987 Chesapeake Bay Agreement. The opportunity exists for all jurisdictions within the Chesapeake Bay watershed, including the non-signatory states of Delaware, New York and West Virginia, to coordinate and cooperate on the transport and proper use of animal waste transported across jurisdiction boundaries. In addition, applied research and technological advances are needed to provide and support a broad range of alternative use options to provide for an economically viable animal agriculture industry that is compatible with a healthy bay ecosystem.

A multi-jurisdiction steering committee convened two task forces to evaluate technical standards for interstate transport and use, alternative-use technologies and possible incentive programs to encourage their development. Representatives from state and federal agencies, universities, agricultural organizations, conservation organizations, agribusiness and the power generation industry participated on the task forces.

The guidelines included in the report are intended to be recommendations to the jurisdictions for addressing operator, public, and water quality concerns relating to the interstate transport of animal waste, and to serve as a policy guide in evaluating and promoting alternative uses of animal waste in the Chesapeake Bay region.

The steering committee held its final meeting on September 14, 1999 in preparation for submitting the final report and recommendations to the Implementation Committee by the October 1, 1999 deadline established by the directive.

Recommendation Summary:

The six states that comprise the Chesapeake Bay basin should consider signing a memorandum of understanding, or similar document, regarding:

> Their commitment to ensuring the proper land application of animal waste regardless of the final destination;
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> The use of nutrient management plans where state incentive programs result in interstate animal waste transport;
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> Sharing of summary data with other states for animal waste that transfers across state lines as a result of state incentive programs; and
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> Designation of representatives to continue to promote coordination and cooperation on interstate waste transport issues; and
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> Use of other guidelines developed by the task force.

The jurisdictions should consider adopting guidelines contained in Section 1 of this report entitled “Technical Standards and Guidelines for Transport, Storage, and Use,”which was developed by the task force. Key components include:

> States should review their existing regulations concerning transport of animal waste;

Animal waste transport vehicles, handling equipment, and spreading equipment should be operated such that the outside body of the equipment is free of animal waste and that animal waste is contained without leakage or spillage;

States should require a written nutrient management plan before a farm is eligible to receive out-of-state animal waste to ensure that proper nutrient rates and timing of land application are used;

Permanent or temporary storage procedures for animal waste should ensure that nutrients or pathogens do not contaminate ground or surface waters;

Biosecurity measures should be implemented to ensure that pathogens are not spread to other farms with similar livestock species or to other production areas; and

Transfers of animal waste should be monitored and tracked when state incentive programs are involved in facilitating manure transport with data periodically provided to receiving states.

Potentially feasible animal waste alternative uses within the Chesapeake Bay basin are: expanded land application, composting, pelletization or granulation for fertilizer, animal feed products, and energy generation. A detailed discussion of these alternative uses is contained in Section 2 of this report entitled "A Guide for Alternative Use Actions in the Chesapeake Bay Watershed." Summary information includes:

The most appropriate mix of alternative use and incentive solutions varies by area;

Areas with slight or moderate nutrient oversupply should focus efforts on expanding the more distant land application of animal waste as well as other secondary uses such as composting for the landscape industry;

Areas with significant nutrient oversupply should pursue at least one more significant waste reuse option such as pelletization or granulation with shipment to nutrient deficit areas, or energy conversion, along with other minor use options;

Alternative uses will be less costly to develop for dryer and more nutrient dense wastes such as poultry;

Nutrient reduction through more effective feeding strategies should be encouraged for liquid wastes, which are more costly to transport for alternative uses;

Incentive programs to encourage alternative uses should be developed, with preference given to recurring incentives with a phase out period; start-up incentives such as grants, loan guarantees, and low interest loans; or insurance mechanisms to reduce risk exposure of adopting a new practice;

Incentive programs should be structured to achieve market based solutions; and
Additional research should be directed to improve and expand adoption of alternative uses for animal wastes.

A commitment to pursue alternative use strategies for animal wastes will require good faith coordination and cooperation among all of the listed organizations. These entities must be willing to contribute funding, risk assumption, and personnel resources. A detailed discussion of appropriate roles is in Section 3 of this report. A summary of these roles include:

Integrators should contribute funding for start-up of alternative use projects, provide matching funds for cost-sharing, be willing to assume risk, and allocate personnel to coordinate alternative use start-up projects;

Livestock growers will need to cooperate so that adequate supplies of manures can be made available for alternative uses;

Manure brokers will need to expand their role beyond that of connecting buyers and sellers of manure;

Fertilizer manufacturers and distributors will need to contribute capital and practical research to evaluate and implement uses for nutrients contained in ash byproducts or pelletized manures;

States will need to assume a number of functions in the best public interest to help facilitate alternative uses. These include: providing research funding to universities and industry to improve the economic feasibility of technological processes important to advancing alternative uses; providing low interest revolving loans for infrastructure development; providing partial loan guarantees to reduce start-up risk; cost-sharing for pilot projects; and potentially providing insurance to farmers;

Federal assistance will need to take several forms including tax incentives and research funding. Federal tax credits are needed to promote alternative fuels for power generation. The Department of Energy and the Experiment Station branch of USDA should cooperatively fund specific research efforts to industry and universities to refine realistic waste technologies such as ash conversion to fertilizer materials;

Utilities should be encouraged to continue to allocate personnel to development of energy conversion systems. Tax credits and research cost-sharing from states and integrators will help enlist their support as well;

The Chesapeake Bay Program should consider actions that provide a coordination role on animal waste use technologies within the Chesapeake Bay watershed. It is recommended that the program policy makers place a priority on funding research that could be expected to close the knowledge gaps identified in this document to further advance the more feasible reuse options for manures. In addition, the Implementation Committee should annually convene the Interstate Animal Waste Distribution and Use Technology Task Force to promote cooperation, to share technological and program progress, and discuss emerging concepts and issues between the signatory and non-signatory states, integrators, farm interest groups, environmental interest groups, the nutrient supply industry, utilities, and other interested parties.

Section 1
Technical Standards and Guidelines for Transport, Storage, and Use

The issues addressed in this section include recommendations for appropriate procedures pertaining to the interstate distribution of animal wastes, storage of animal waste to allow for timely usage, development of a protocol for data sharing and monitoring of animal waste distributed across state boundaries, and mechanisms for interstate cooperation and coordination. These guidelines are intended to be recommendations to the jurisdictions for addressing operator, public, and water quality concerns relating to the interstate transport of animal waste. Each jurisdiction should review its appropriate programs and requirements to make sure water quality issues concerning manure transportation, storage, and use are addressed.

Transport Procedures and Standards

States already have certain laws in place that address the transport of materials. Each state should conduct a review of its regulations to determine if they are adequate to address loss of material from transport vehicles and if they address bio-security issues associated with manure transport. Regulations of truckers hauling manure, registration and reporting by transporters should be kept to a minimum to encourage transport to suitable sites.

Unless otherwise restricted, farmers may engage in the interstate transport of animal waste generated by their operation for use on their own land, however the following guidelines would still apply.

Transportation Vehicles:

The following comments apply to any means of transporting manure between states such as trucks, rail cars, and barges. Dedicated application and handling equipment is considered in another section.

1. A summary of the state regulations and any additional requirements deemed necessary to supplement regulations should be made available to manure haulers.

2. Transport vehicles should be free of manure on the outside of the body and undercarriage, and must be able to contain the manure within the cargo area without any loss of material or liquid during transport.

Application and Handling Equipment

1. When application equipment travels on public roads for interstate transport, the equipment should be free of manure on the outside of the body and undercarriage and must be able to contain the manure within the bed of the applicator without any loss of material during transport to and from the application site.

2. Equipment used for application and handling of manure for use on other animal operations should follow acceptable sanitation procedures to address bio-security issues.

Proper Storage of Animal Waste to Allow for Timely Usage

1. States should require a written nutrient management plan before a farm is eligible to receive out-of-state animal waste.

2. Permanent storage should meet NRCS and/or state specifications for the type of manure, conditions existing at storage site, and estimated length of time of storage established in each state.

3. Temporary storage of manure on site may be utilized if the following practices are followed:

    a. Only manure which is stackable, containing less than 40 percent moisture, may be temporarily stacked outside.
    b. Soil depth to bedrock and/or separation distance to seasonal high water table must be adequate to ensure that nutrients from stacked manure are not carried into groundwater or surface waters.
    c. Location of stacked manure on slopes and in fields adjacent to drainage ways and/or surface waters must be protected so that runoff water from stacks does not enter these features.
    d. Manure should not be stored in areas where potential flooding may occur or stored in areas during seasons when those areas may be prone to flooding.
    e. Stacks should be at least 100 feet from any surface water.
    f. Stacks that are not to be spread within a reasonable time period (approximately 2 weeks) should be protected to ensure that nutrients and pathogens do not contaminate groundwater or surface water. Such protection could be achieved by means including: covering stacks with a waterproof tarp or black plastic which is anchored to the ground; or storage on concrete or other impermeable base with runoff and leachate collection basins. Stacks on slopes also should have a diversion ditch installed at least 50 feet on the uphill side from the stack to divert storm water around the stack.
    g. A temporary storage site should only receive the amount of manure needed for the cropping season, as specified by the nutrient management plan.

Appropriate Bio-security Measures

1. The waste supplier should certify in the required written agreement (recommended below under *Utilization, timing, and rates*) with the receiving operator that the supplier's herd or flock was not under quarantine or known to be infected with any contagious disease during the period of production of the waste. If not, the operator of any of receiving premises with the same or similar species should consult the state veterinarian of the receiving state before accepting delivery.
2. Vehicles hauling manure should be thoroughly cleaned of all material at the point of delivery before transporting any other freight, especially if they are back-hauling into an area of confined animal feeding operations.

3. The state veterinarian of the receiving state should be notified of potential transport of manure from farms having animals with contagious diseases and should be given the authority to approve or deny receipt of the manure.

Utilization, Timing and Rates

Participating jurisdictions should require the implementation of written nutrient management plans for operations receiving out-of-state animal waste. These plans would be based on the laws, rules and regulations of the jurisdiction where the receiving operation is located. Each jurisdiction should review its requirements and programs to determine if they are adequate to protect ground and surface waters, including the Chesapeake Bay. It is suggested that site-specific nutrient management plans should contain the following items:

1. Nutrient management plan development and implementation should include all existing and imported sources of nutrients, consider crop nutrient needs, and include nutrient handling, storage and application procedures to protect water quality as established by each jurisdictions nutrient management program.

2. Animal waste analysis should be completed prior to transport to facilitate accurate application rate recommendations consistent with the nutrient management plan.

3. Animal waste transport should be covered by written agreements between the waste supplier and the receiving operation. The agreement would become part of the nutrient management plan to verify amount of waste and when it would be delivered.

4. Plan development should include a review of the receiving site to determine if water resources will be adequately protected by the nutrient management plan. As needed, additional measures, such as spot checks should be added to the plan to assure compliance with the conditions outlined in the plan.

5. Incentive programs should encourage proper transportation, storage, utilization and application of animal waste and compliance with applicable regulations and guidelines.

Monitoring and Tracking

1. States will assist in monitoring and tracking any transfer of animal waste originating within their jurisdiction when state incentives programs are involved in manure transport. Data collection procedures may vary between states based on each jurisdictions information reporting requirements. Aggregate summary data should include species type, tons or gallons of waste transported out-of-state, and destination by state and county. The state where the waste is produced should provide this data to each receiving state on an annual basis.

2. Farmers and planners should have a record of manure usage and its origin based on the nutrient management plan and by the written agreement between the animal waste supplier and the receiving operation. Jurisdictions should establish a threshold amount below which records for transport of animal waste are not necessary. A threshold level of 20 tons of animal waste transported annually to a single receiver is suggested to states for these purposes.

3. Tonnage information of transported animal waste for tracking could be obtained from nutrient management plans, incentive program participation, manure transporter records, and/or participating farmers.

Coordination and Cooperation

1. Interstate animal waste distribution should be addressed by an Memorandum of Understanding among the participating states. A draft MOU is attached as Attachment 2.

2. The interstate effort will be pro-active and positive between all parties.

3. The movement of animal waste to regions that have the ability to utilize the waste will be encouraged.

4. Interstate cooperation should include the assignment of coordinators for the waste/nutrient management programs for the participating states, who will meet or conference call at least once a year to discuss the interstate waste transport issues of concern.

Section 2
A Guide for Alternative Use Actions in the Chesapeake Bay Region

The purpose of this section is to serve as a policy guide in evaluating and promoting alternative uses of animal waste in the Chesapeake Bay region.

Need for Strategic Process in Evaluating Alternatives

The goal of proper animal waste utilization in the Chesapeake Bay watershed is to optimize the economic and societal benefits of use in a manner which protects the environment. Promoting the highest economic use of these materials may decrease the degree of regulatory oversight necessary to achieve environmental protection. A high economic value tends to reduce the potential for wasteful or inappropriate uses. A low or negative economic value of waste material tends to create incentive to dispose of the material in the least costly manner. This may likely not be the most environmentally friendly end use, leading to a greater potential need for environmental regulation to safeguard the environment.

No single solution will solve regional nutrient imbalances resulting from commercial fertilizer use and manure nutrients generated from livestock operations across the entire watershed. Each area of concentrated animal production has a different mix of animal types, set of land base resources, proximity to potential market areas for waste products, and varying degrees of existing infrastructure to handle animal waste or by-products of animal waste utilization processes. In addition, potential market sizes, particularly for some niche markets, are not sufficient to absorb all of the excess waste produced in some areas. Conversely, promoting too broad a range of alternative uses through a variety of incentive programs may also eliminate some potential large volume uses of manure by bidding up the on farm "price" of manure to a level that is cost prohibitive for the particular use. ***Those in areas of confined animal production in the watershed with nutrient loadings that only moderately exceed crop requirements should encourage, through incentive programs and other means, more distant land application along with other uses such as composting and feeding waste materials. In areas with more significant nutrient imbalances relative to available land for application, at least one significant waste volume demanding end use is likely necessary, such as energy conversion or pelletizing into fertilizer products, along with expansion of other minor use options.***

Current environmental regulations and the movement toward phosphorus based nutrient management plans will tend to decrease the farm "price" of manure and increase the amount available for transfer off the farm to other potential uses. With no other interferences, a lower price of manure at the point of production would improve the economic feasibility of various reuse options. The impact may be largely borne by the grower in this case, whether receiving a lower price for manure which is sold or paying a custom hauler to take manure. Regulatory pressures, such as mandatory nutrient management plans for confined livestock farms, will probably increase the available supply of animal manures for other uses in certain areas. Concurrent strategies that focus on increasing the demand for animal manures could work in concert with the increasing regulatory environment to promote alternative uses. ***An appropriate strategy may be to target incentives toward specific larger volume alternative uses that are the most effective uses of public funds and will be most likely to result in long term beneficial uses of manure.***

The economics of transport and certain alternative uses is largely influenced by the concentration of nutrients contained in the material, moisture content, and the relative ease of handling the material. Poultry manures, with their relatively low moisture content and high nutrient analysis are favored in this regard over dairy or swine manures. ***Where multiple animal industry sectors (poultry, beef, swine, dairy, etc.) exist in areas with high nutrient loads relative to cropland, the least costly regional solution to an insufficient land base for application may be to favor alternative use options for manures which are more concentrated in nutrients and easier to handle.*** This would preserve the regional land base to be used for land application of less readily transportable wastes. However, regional nutrient imbalances are the sum of farm level nutrient imbalances within the region. Since all land is not shared openly with neighboring farmers, alternative solutions may be necessary for all manure types.

For less nutrient dense animal waste types, nutrient reduction in manures through more efficient animal nutritional feeding strategies is crucial. This strategy is particularly important for manure collected and stored in a liquid form, such as most swine and dairy manure, as transportation of liquid manure is very expensive, making many of the other manure use alternatives infeasible. This will require research and implementation of technologies such as enzyme addition to feeds that increase nutrient availability to animals, low phytic acid corn, and more efficient nutritional balancing techniques. Use of these strategies would enable higher land application rates of manures and result in lower transportation and utilization costs since a given amount of manure could be utilized on a smaller land base. Cost-share incentives, matching grants for enzyme injection equipment, or some form of insurance incentive could speed the adoption process for these methods of nutrient reduction.

Incentive Mechanisms

Incentive programs should be structured so that any cost-sharing or other incentive mechanisms are placed at the demand end, rather than the supply end. The purpose of the incentive should be to improve the demand at the end use point or in the market channel, not to directly offset manure disposal costs at the point of production.

A number of incentive mechanisms could be employed to stimulate alternative uses of animal manures. Incentives may be grouped as recurring, recurring with a phase-out period, start-up, or insurance. Recurring incentives could be necessary when the economics of a particular end use is not expected to be self sustaining. Examples of recurring incentives would be transport expense cost-sharing to move animal waste to a utilization point, or an energy tax credit for using animal waste as fuels. Long term commitments from government and industry would be required to maintain this strategy. Recurring incentives with a phase-out period should be considered where it is believed that self-sustaining markets may be developed in the long run, but an adoption incentive is necessary to convince the end user to try a new method or to defray start-up and infrastructure costs and reduce risk during the initial years of market development. Such incentives might prove useful in encouraging full service manure broker applicators or fertilizer companies to enter the business of manure redistribution. Start-up incentives could include grants, loan guarantees, and low interest loans to develop uses believed to be economically sustainable in the long run, but perhaps too risky for private enterprise to initiate without some outside help to defray some start-up costs and to lower initial financial risks. Another type of subsidy for these types of enterprises would be insurance to manage uncertainty in adopting a new practice.

Brief Descriptions of Alternative Animal Waste Uses

A range of potentially feasible options exists to utilize animal wastes produced within the Chesapeake Bay watershed. These include land application of raw materials, composting, pelletization (or granulation) for fertilizer, animal waste utilization as a feed, and energy conversion.

Land Application

Land application of raw materials will likely remain a significant end use of animal wastes, not only on the farms that produce the manure, but on surrounding farms as well. Phosphorus based nutrient management planning will require a greater land area for environmentally safe application in the future.

A number of brokers and custom applicators now operate in several areas of large scale production of poultry litter. In other cases, area crop farmers sometimes are equipped to clean out litter from poultry houses of neighboring farms. Prices now received for litter range from free to about $7 per ton depending upon the area, season, and quality of litter. Custom haulers also exist for dairy manure in some regions, but, these haulers frequently apply primarily to land controlled by the farm which produces the manure. Swine farms have almost always been self contained units having sufficient land available for manure application on a nitrogen basis, and applying this manure with on-farm labor. However, phosphorus based nutrient management planning would require additional land area or alternative use strategies for many swine farms.

A disadvantage of redistribution and land application of manures within livestock production areas is the potential for disease transmission, and this risk is more significant with this alternative use option than with most other alternatives. Transport of raw animal manures to and from a number of farms using the same trucks or spreading equipment, as a custom applicator may utilize, requires that strict biosecurity measures be implemented. Transfer of pathogens between farms remains one of the industry's greatest concerns.

In areas of dense confined animal production relative to land available for utilization, transport of manures to outlying areas is the only option if manure is to be applied to land. Manure transport can be encouraged in several ways including farmer education in receiving areas, hotlines to match buyers and sellers, entrepreneurial activities of manure brokers and custom haulers, and/or cost-share subsidies to lessen the end user's cost of transporting manures. If transport subsidies are put in place, these can either be planned for the long term or used for shorter terms to encourage first time manure users in receiving areas and to help offset the economic cost and risk to develop a brokerage and custom hauling industry. In the latter case, end user education is essential and hopefully tend to result in continued usage after the subsidy is phased out. Because markets for some manure types have already developed in many areas of the watershed, any transport incentives should focus on expanding the transport mileage radius for feasible utilization. Transport incentives should not be designed to cover 100 percent of transport costs. If the receiving farmer has little or no investment in the manure, there is a greater potential for misuse. ***It is important to reduce the sum of nutrient loss potential across the watershed, not simply relocate the problem to areas more distant from animal production locations.*** The subsidy should start at the current boundary of the economically feasible hauling distance that exists without a subsidy. Beyond that point, the subsidy could be scaled according to distance so that new users pay the same price as those close to the current boundary. This would result in a less costly program, thereby minimizing government and integrator expense.

Composting

Composting is a biological process in which microorganisms convert organic materials such as manure, newspaper, straw, sawdust, wood shavings, and leaves into a soil like material called compost. The process may take several months. It requires attention to mixing ratios of the various materials, may need the addition of water and requires periodic remixing or aerating of materials during the process. Composting converts most of the inorganic nitrogen in manures to more stable organic forms of nitrogen.

Higher rates of compost application than that of raw manure would be required to provide the same amount of plant available nitrogen for crop production. Since phosphorus will become more concentrated in the composted product relative to nitrogen available to plants, more pronounced over-application of phosphorus will occur.

Potential markets for compost products may include: use as a soil amendment for high value crops like vegetables or organic farm products; use in marginal land reclamation such as vegetation establishment on strip mines and highway road cuts, and as a base for constructed wetland foundations; horticultural industry uses for container media; landscaping uses such as golf course construction and renovation.

Composting essentially eliminates pathogen and disease transmission potential, therein addressing biosecurity issues. Objectionable odors are not usually generated from either transported or land applied compost, thereby avoiding most public acceptance concerns. Odor generated at the compost site, however, could be a nuisance if the process is not properly managed.

For land reclamation activities, it would be more practical and economical to simply incorporate raw manure along with a carbon source such as sawdust or wood chips directly into the soil, thus bypassing the composting process. With attention to proper mixing ratios, this process would be similar to composting in that nitrogen in the manure would be converted to more stable forms less likely to leach or runoff.

Many commercial composting operations now exist in the region. This use for animal manures can probably be expanded. Technical experts and some current compost producers believe the current market in many localities is not close to saturation and could be developed further. Composting operations are more likely to be successful on a small to moderate scale, servicing local areas because of transportation costs of the bulk materials and end product. To be economically viable, low or no cost animal manures as a nitrogen source must be available as must be a source of carbon such as newspaper, leaves or wood chips that lead to tipping fees. In addition, end use markets should be in reasonably close proximity. This use of animal manures cannot be expected to utilize all excess manure, but can partially contribute to a solution.

Incentives to encourage composting could include transport cost-share to defray the cost of manure sources; tipping fees at local landfills for brush, yard waste, and leaves to encourage or provide for transport of these materials to composting operations; or low interest loans for facilities and equipment for potential composting operations. Regulatory burden on potential compost operations could be reduced by adopting general permits for these facilities.

Pelletization or Granulation for Fertilizer

Pelletilization or granulation involves dehydrating manure through a heat process and pelletizing or granulating the material. Granules are smaller than pellets, and various end users may prefer one form over the other depending on how the product will be applied and what other fertilizer materials may be mixed with the pellets or granules. For the purposes of this document, both forms will be referred to as “pelletized” manure. The moisture reduction concentrates the nutrient content, reduces weight for transport, and the pelletization makes handling and spreading with dry fertilizer application equipment possible. As compared with raw manures, the easier handling and consistency of product is important to gain consumer acceptance in the urban and suburban markets.

However, pelletized manure is bulkier than commercial fertilizer products. Compared to commercial fertilizers, several inefficiencies are associated with its usage. Long distance transport would be less feasible. Additional storage would be required along with more trips to the field with spreading equipment. Nutrient content and nutrient availability to crops is somewhat variable, although to a lesser extent than with raw manures. To compensate, farmers may slightly over-apply these materials or processing firms may guarantee a conservative nutrient content, thereby resulting in some degree of environmental over application of nutrients. Because of these differences, these products will either need to compete in the "high end" specialty fertilizer market or be priced considerably lower than commercial fertilizers in order to compete.

To bring nutrient ratios into better balance with crop nutrient needs, commercial nitrogen or potassium fertilizer materials can be injected during the pelletization process. This would reduce phosphorus application rates to match crop needs and result in a more marketable end product for farmers or other fertilizer users. While this approach would rely somewhat on imported fertilizer supplementary materials, this would probably be substituting for fertilizer that would enter the crop production system at some other location.

From a societal perspective, the phosphorus, potassium, and nitrogen materials in fertilizers that are mined or produced must be transported, and energy is consumed in the manufacturing process. In the long run, it makes sense to recycle the manure nutrients imported to farms in feeds in a manner that returns the nutrients for use in feed production rather than continually mine and manufacture inorganic fertilizers. Pelletized manure from concentrated animal production areas could be shipped to grain producing regions in the Midwest in the same rail cars used to import feeds, thus generating a more sustainable system. As the supply of mined fertilizer materials begins to diminish in the future, such recycling concepts will be more economically competitive. Since it may not be possible to wait for this situation to develop, some level of start-up subsidy may be necessary. Because of the environmental concerns associated with excess manure quantities in certain areas of the watershed, it would seem appropriate for public and private funds to be invested in infrastructure if the resulting enterprise can be economically self-supporting after start-up.

Animal Waste Utilization as Feed Products

Poultry, finishing cattle, and swine wastes have characteristics which make these materials usable for feed sources because they contain nutrients, protein, amino acids, and fiber. Broiler litter is utilized within some areas of the region as a cattle feed supplement. High quality broiler litter currently sells for $10 to $12 per ton for this use, and transport economics may be favorable for use in areas 300 miles or more from the source. Potential also exists to utilize animal wastes as a component of feed pellets. In some countries, animal waste is utilized in confined fish production systems.

Significant quantities of broiler litter are already used as a cattle feed supplement in parts of the watershed. Litter must be dry stacked for at least three weeks prior to use so that the material can go through a heating process to kill bacteria and other organisms that may be harmful to livestock.

Targeted educational efforts by Extension and others should continue to focus on beef producers. Public perception could limit the potential for wide scale rapid expansion of this use, although research has shown that there are no adverse impacts in animal meat from animals that are fed these materials. Public education is not likely to be successful in increasing the public acceptance of this practice, but research should be continued to provide scientifically based response should public concern issues arise. Another potential drawback to this use option is a relatively high variability of demand from year to year. In years of good forage production, litter transport for feed will be depressed. This lack of predictable demand is a major problem for integrators and growers who want to move a relatively constant amount of manure each year. Transportation cost-sharing may increase the potential for this use, but this use of broiler litter is believed to be economically sustainable without the need for incentives in areas where beef cattle are produced within several hundred miles. Therefore, any transportation cost-sharing to promote this use should be for a limited time frame just to encourage adoption of the practice.

Energy Generation and Residual Ash Reuse

Energy conversion systems for animal waste have not been commercially implemented on a large scale to date in the United States. However, two processes may be commercially feasible. These technologies are capital intensive and involve significant risks, but would potentially utilize significant quantities of animal waste and produce a byproduct that could have economic value as a fertilizer material. A commitment to research efforts, either in incremental phases or by developing one or more pilot projects, would greatly assist in evaluating these processes.

Incineration

It is possible to burn some animal manures to produce electricity, either as a primary fuel source or as a fuel mixture. For example, poultry litter is burned at some power plants in Europe. The resulting ash may be of some value in fertilizer manufacture. Co-firing of manures with other fuels may have potential, but may not be feasible with some fuels because of the content of the residual ash, unless the ash is to be landfilled. The impact of other fuels in the mix would need to be evaluated for any adverse impacts of ash reuse. A two step reuse process wherein energy is produced and a market is developed for the nutrients contained in residual ash would be a more efficient use of manure. Existence of power plants that could be retrofitted would improve the feasibility of this option. The combination of factors necessary may exist on the Eastern Shore for this end use at an existing utility facility.

Gasification

Gasification is a process whereby CO_2, methane, and other gasses from heated manure is introduced into a combustion chamber. The resulting heat is used to produce steam for industrial purposes. It may be possible to develop this process on a smaller scale than may be necessary with incineration if the facility is co-located with an industrial user of steam. Gasification could produce a significant volume reduction in animal waste. Like incineration, developing a reuse market for the residual ash may be critical to improve the feasibility of this process. Research and start-up costs may need to be subsidized to facilitate this option. A regional utility has begun investigating potential for the gasification process to utilize animal waste.
For either of the two energy conversion options, dryer manure types, such as poultry, are more likely to be feasible for this use since less energy is expended to remove moisture during or before the combustion process. Supply management of the source manure is critical for either incineration or gasification. A large and continual supply of manure would be necessary throughout the year or only during times of need for peak energy demand. This would require significant integrator involvement to coordinate clean-out schedules of supplying growers.

Research addressing reuse of the ash from energy conversion systems is crucial to improve the long term economic feasibility of either energy conversion process, and the knowledge gap concerning this issue is one of the most significant unknowns of all the alternative animal waste uses presented in this document. The content of trace metals and other constituents in the ash must be investigated so that potential end uses of this by-product are knowledgeable of its content. This would best be accomplished through a joint effort between utilities, integrators, the fertilizer industry, and land grant universities. To further evaluate the incineration process, it is possible to conduct test burns to determine the level of air emissions and generate a limited supply of ash for analysis purposes. Because of the uniqueness of the gasification process, it is not possible to duplicate the exact energy conversion processes easily on a small trial basis to produce ash for research, to a greater level of risk would need to be assumed concerning the value and potential uses of residual ash from a pilot project.

For energy conversion systems to be viable, experts familiar with the processes believe subsidies would definitely be needed to defray start-up costs and possibly for recurring costs. Incentives to encourage energy generation could be transport cost-sharing, tax credits on energy produced from animal waste, low interest loans to retrofit plants, or partial loan guarantees for start-up ventures.

Section 3
Anticipated Role of Industry and Government Agencies

A commitment to pursue alternative use strategies for animal wastes will require good faith coordination and cooperation among all of the listed organizations. These entities must be willing to contribute funding, risk assumption, and personnel resources.

Integrators should contribute funding for start-up of alternative use projects, provide matching funds for cost-sharing, be willing to assume risk, and allocate personnel to coordinate alternative use start-up projects. Integrators may need to exercise their option for asserting greater control of animal waste produced on contract farms through contract renewal negotiations with growers to ensure a constant and adequate supply of animal manure needed for certain alternative uses. If the animal waste has a market value, integrators should compensate growers through contract adjustments. Because of the potential to ensure a reliable manure supply, integrators would be in a better position to become involved in enterprises or joint ventures that process manure but not in marketing fertilizers derived directly from manure or energy conversion by-products because their lack of expertise in this area. It is in the industry's best long-term interest to pursue cost-effective solutions to animal waste issues to reduce potential environmental liability exposure.

Livestock growers will need to cooperate so that adequate supplies of manures can be made available for alternative uses. The farmers most willing to cooperate should be those with inadequate land base to utilize manure in an environmentally sound manner. Livestock growers with land available for the application of manures should retain access to the manure for their own use. Farmers who are not confined livestock producers will need to be convinced to accept nutrients in forms other than commercial inorganic fertilizers.

Manure brokers will need to expand their role beyond that of connecting buyers and sellers of manure. Aggressive brokers will need to expand into service roles including custom application and development of nutrient management plans for manure users to facilitate the efficient relocation of unprocessed animal waste to areas where it can be used.

Fertilizer manufacturers and distributors will need to contribute capital and practical research to evaluate and implement uses for nutrients contained in ash byproducts or pelletized manures. Aggressive companies will define their businesses as crop nutrient suppliers, not narrowly defined as selling a single source of nutrients. Increasing regulatory pressures are requiring that animal manure nutrients be utilized effectively. More land application of manures will reduce demand for commercial fertilizers. Fertilizer companies can chose to view manure derived products as market share competitors, or they can chose to work toward partially replacing current fertilizer materials within their business enterprises. They need to work with integrators to identify how animal wastes can be used economically in their existing operations. Business mergers often fail when companies become involved in enterprises in which they have no technical or managerial expertise. The fertilizer industry should handle storage, distribution, and application of manure based fertilizer materials.

States will need to assume a number of functions in the best public interest to help facilitate alternative uses. These include: providing research funding to universities and industry to improve the economic feasibility of technological processes important to advancing alternative uses; providing low interest revolving loans for infrastructure development; providing partial loan guarantees to reduce start-up risk; cost-sharing for pilot projects; and potentially providing insurance to farmers who purchase manure for fertilizer in case of yield shortfalls should manure nutrient availability not meet expectations.

Federal assistance will need to take several forms, including tax incentives and research funding. Federal tax credits are needed to promote alternative fuels for power generation. Such credits might best focus on infrastructure development and retrofits rather than recurring subsidies. The Department of Energy and the Experiment Station branch of USDA should cooperatively fund specific research efforts to industry and universities to refine realistic waste technologies such as ash conversion to fertilizer materials.

Utilities should be encouraged to continue to allocate personnel to development of energy conversion systems. Agricultural enterprises are major customers for electricity, and a strong economic industry base is important to these companies. Tax credits and research cost-sharing from states and integrators will help enlist their support as well.

The Chesapeake Bay Program should consider actions that provide a coordination role on animal waste use technologies within the Chesapeake Bay watershed. It is recommended that the program policy makers place a priority on funding research which could be expected to close the knowledge gaps identified in this document to further advance the more feasible reuse options for manures. In addition, the Implementation Committee should annually convene the Interstate Animal Waste Distribution and Use Technology Task Force to promote cooperation, to share technological and program progress, and discuss emerging concepts and issues between the signatory and non-signatory states, integrators, farm interest groups, environmental interest groups, the nutrient supply industry, utilities, and other interested parties.

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